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# IMPERFECT INFORMATION AND MONOPOLISTIC COMPETITION

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ABSTRACT

This paper reviews recent search equilibrium models to see whether usable policy instruments can be derived from them. It concludes that the strength of the assumptions that many of these models make largely precludes such derivations, and ends by sketching possible lines of research that have both positive interest and the potential to yield helpful normative conclusions.

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# IMPERFECT INFORMATION AND MONOPOLISTIC COMPETITION

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## I

Ever since the pioneering work of Stigler (1961) and the provocative survey by Rothschild (1973), economists have clearly recognized that general equilibrium models yield competitive equilibria only by making strong assumptions about the extent of information available to market participants. These models also seem inconsistent with observed data; for they predict single price equilibria while price dispersion that is not accounted for by product or contract term heterogeniety or by price discrimination apparently is pervasive. In response to these perceived defects in the neoclassical models, theorists in recent years have developed a family of ''search equilibrium models'' that presuppose product homogeniety and the absence of price discrimination, but which also assume that information acquisition costs are positive for at least a subset of buyers. On the basis of these and other assumptions, the models attempt to show how price dispersion equilibria can arise solely as a result of the strategies that firms and consumers pursue. One author summarized the results: ''If information is costly, each small firm obtains market power,'' so that ''The relevant market structure with imperfect information is not perfect competition but rather monopolistic competition.''[1]



The defects of the neoclassical models are also interesting normatively. To see why, suppose that (i) products and contract terms in a given market are homogeneous; (ii) no price discrimination occurs; (iii) entry is free, so that in equilibrium all firms earn zero expected profits; (iv) goods are homogeneous; and, (v) as a result of insufficient consumer search, three prices obtain: $2, where price equals long run average cost, $3 and $4. An equilibrium of this sort potentially is inferior to a competitive equilibrium in which all firms charge $2. This is because if the government were to cause search to be increased such that price was driven down to $2, consumers would be made better off but firms no worse off. If this welfare gain would exceed the costs of such regulation, the state should regulate. That search costs are positive, then, is of normative interest because those costs could generate supracompetitive prices. Policy analysts thus should want to know: (a) when is insufficient search, rather than other factors, likely to cause supracompetitive prices? (b) how can markets that behave badly for information reasons best be moved toward competitive equilibria? (c) when are the costs of regulation to cure this sort of market failure likely to exceed the welfare gains?

Some theorists and most decisionmakers assume that the answer to the first question is ''often, especially in consumer markets'', a position that the evidence fails convincingly to sustain.[2] Economists also seldom ask the last two questions.[3] And decisionmakers have ignored the last question while transmuting the second into the

inquiry whether the ''typical'' consumer lacks <u>any</u> information that he or she would find useful in making a ''rational'' choice. If so, an information problem justifying regulation is assumed to exist (Landers 1977; Landers and Rohner 1979). The economists' concentration on theory and the policymakers' ignorance of economics thus has produced a large amount of regulation, much of which might be unnecessary and most of which is expensive to administer and obey.

The search equilibrium models described above focus attention on the strength of the informational assumptions that the neoclassical models make and on the potentially unpleasant normative consequences of relaxing those assumptions. These newer models, however, make strong assumptions of their own, in particular respecting the methods by which the consumers in them become informed and the nature of consumer expectations. Part II of this paper next discusses the consequences of making assumptions of this sort; it then argues that because of them most search equilibrium models do not readily yield usable policy instruments. Part III then briefly sketches lines of research that seem interesting positively and that may generate helpful normative conclusions.

## II

A useful way to begin is with the original and widely cited model of Salop and Stiglitz (1977). These authors suppose that (i) finite numbers of firms and consumers exist; (ii) a homogeneous good



is sold and consumed; (iii) no price discrimination occurs; (iv) consumers desire to purchase one unit of the good and will pay any price up to a common limit price; (v) consumers have rational expectations in that they know the true distribution of prices in a market when they begin to search, but do not know which firms charge these prices; (vi) consumers fall into two classes, as measured by the costs to them of becoming informed, with the low cost group having information acquisition cost $c_1$ and the high cost group having cost $c_2$, where $c_2 \geq c_1 \geq 0$; (vii) becoming informed is viewed as purchasing and reading a newspaper that reveals the relationship between firms and prices; (viii) consumers who become informed always buy at the stores that charge the lowest price while consumers who do not become informed visit one store chosen at random and buy if the price is less than or equal to the limit price; (ix) firms have U-shaped average cost curves; (x) firms maximize profits and in equilibrium earn zero expected profits.

To facilitate comparison of this with other models, we shall modify these assumptions in two ways: suppose that (i') arbitrarily large numbers of consumers and firms exist, with the consumer/firm ratio the endogenous variable; and (ix') firms' technologies are described by a fixed cost and a marginal cost that is constant up to some particular capacity level, after which it becomes infinite.

To summarize Salop and Stiglitz's results, introduce the following notation: $p_L$ = the consumers' common limit price; $p^*$ = the competitive price = $\hat{p}$ + (F/s), where $\hat{p}$ = marginal cost, F = fixed

cost, and s = the capacity constraint; $\alpha$ = the proportion of consumers with low information acquisition cost ($c_1$). The Salop and Stiglitz model generates a competitive equilibrium if and only if enough consumers have zero information acquisition costs -- if $c_1 = 0$ and $\alpha > 1 - [F/s(p_L - p)]$. If these two conditions are not met, a number of possibilities arise: all firms charge the monopoly price -- it never pays any consumer to seek a lower price -- if $p_L - p^* \leq c_1 \leq c_2$. In other cases, there exist two-price equilibria with the low price being $p^*$ and the high price being either $p_L$ or a price intermediate between $p^*$ and $p_L$. Finally, plausible cases also occur in which no equilibrium exists.

There are four related difficulties with work of this sort. First, the particular rational expectations assumption used is strong; before they begin to search, consumers never know and could not know the entire price distribution unless they also knew the identity of the firms charging these prices. Second, the institution by which consumers become informed -- buying a newspaper that contains <u>all</u> relevant information -- does not exist. Third, nonexistence may occur more frequently than the authors suppose because on this model's assumptions it is unlikely that two distinct groups of consumers will exist. Since consumers are assumed to be identical in all respects except analytical ability and the opportunity cost of time, two groups of consumers will exist only if the high cost group has considerably less ability than the low cost group to read the newspaper and match what they <u>know</u> is the lowest price to the name of the firm that



charges it, or if the high cost group attaches a much greater value to the twenty or so seconds it will take to do this than the low cost group does. Because either possibility is implausible, only one consumer group actually would exist; everyone in this model would buy the newspaper and be perfectly informed or no one would. And since the authors show that a competitive equilibrium cannot exist when $c_1 > 0$, there will either be a monopoly equilibrium -- where $p_L - p^* < c_1 = c_2$ -- or nonexistence. Fourth, as just noted, the rational expectations assumption in this model ensures that a degenerate equilibrium at the competitive price cannot exist if all consumers have positive information acquisition costs. This conclusion reduces the model's policy significance. Policymakers commonly perceive themselves as having to choose between regulating a transaction to achieve a desired outcome or reducing search costs to improve the outcomes markets will reach. Whether the ''regulation'' or ''disclosure'' option should be chosen is in part a function of the nature of the equilibria that would be produced if information acquisition costs were reduced. These costs never can be reduced to zero, and Salop and Stiglitz show that in this case competitive equilibria are impossible but do not otherwise indicate what the effect of reducing search costs would be. Thus it is difficult to draw insights from their theoretically interesting model that would illuminate the choice between regulation and disclosure. In addition, the model cannot generate criteria which decisionmakers can use to characterize observed behavior because it yields nonexistence over

relevant ranges of the underlying parameters.

More recent work has advanced the Salop and Stiglitz analysis; however, it too makes strong assumptions about methods of information acquisition and about the strategies that some of the economic actors pursue. Varian (1980), for example, supposes uninformed consumers to visit one store at random and purchase if the price they see equals or is less than the limit price, and informed consumers to shop at the stores charging the lowest price. Consumers again become informed by reading a newspaper that communicates the relationship between firms and prices, but the decision to become informed is taken to be exogenous. Finally, Varian assumes every firm to have declining average costs, with no capacity constraint. Firms are allowed to pursue mixed strategies. Thus they may randomly choose a different price each period (a ''week''). If this turns out to be the lowest price, the firm sells to its share of the uninformed consumers and all the informed; otherwise, it sells only to the uninformed that week and loses money. Varian proves the existence of a mixed strategy equilibrium in which all prices are charged with positive probability, from the lowest, where price equals average cost for the successful firm that captures all the informed consumers plus its share of the ignorant, to the highest, which equals the limit price.

This model relaxes the rational expectations assumption, for the uninformed consumers in it are not assumed to know the price distribution, but its assumptions respecting firm costs and the method of information acquisition are again unrealistic. So also may be its



assumption respecting the way firms price. To see why this is so, suppose that on Tuesday a firm sends in its ad to the newspaper with its price for the following week; on Monday morning of that week the newspaper comes out and the firm then learns that it does not have the lowest price. It then has an incentive to raise its price to the limit price for the rest of the week. The model implicitly assumes that such price increases will not be made, but this assumption needs justification. Firms adhere to advertised prices because in some circumstances they are legally bound to do so and because altering advertised prices could cause good will losses if consumers commonly assume those prices to be fixed for short periods. Consumers in this model who visit a firm that is not low for the week, however, have not observed the firm's ad; if they had, they would also have observed the ad of the lowest priced competitor and gone there. No legal prohibition against altering prices on which consumers do not rely exists, so it is only the concern for good will that would prevent a firm from raising its price. But this concern seems weak in the context of the model, for consumers who visit a high priced firm by definition have not observed its ad and thus would not realize that the price they see is higher than the price they might have seen had the firm been low for the week; put simply, consumers who see ''changed'' prices would have no reason to believe they were being treated unfairly. The results in Varian's model are sensitive to his assumption that firms will not alter advertised prices. If neither the law nor the prospect of lost good will are relevant to firms, they

would maximize profits by raising prices to the limit in those periods when they were not low. This is because consumers always purchase unless the price is above their limit. Thus the equilibrium in this model actually could involve all but one firm charging the monopoly price in each period.[4]

For these and other reasons, Varian's imaginative model is difficult for decisionmakers to apply. It shows that an increase in the number of uninformed consumers will cause the average price that this group pays to rise, which suggests that welfare gains are possible if the state were to make information easier to get. But this outcome could obtain only if the firms that were not low for a given week were prohibited from raising their prices, and this may be a difficult prohibition to enforce. Also, the model shows that the prices paid by informed consumers could decrease with increases in the size of the uninformed group, making the welfare effect of legal intervention ambiguous. Until these difficulties are resolved, it is difficult to distil directives for action from this model.[5]

In an important sense, the qualms we have expressed about these models are beside the point; the models reflect thoughtful attempts to deal with even more serious defects in prior work and their authors apparently were not intent on producing analyses that would be immediately useful to decisionmakers. Nevertheless, the reliance of these search equilibrium models on strong versions of the rational expectations assumption combined with their use of imaginary institutions by which consumers become informed are the source of some



difficulty even when the models are taken on their own terms. In particular, they seem responsible for the '' discontinuous'' nature of the equilibria these models generate, which are of concern theoretically.[6] Also, given the great amount of regulation that has been passed to cure the allegedly harmful effects of imperfect information, it now seems useful for economists to address the questions that decisionmakers should want answered. The Salop and Stiglitz model and its various extensions thus are best viewed as ''worst-case'' examples of what may occur when information acquisition costs are positive. A useful next step is to develop models intermediate to them and the neoclassical models discussed in the introduction to this paper. One way to do this is to weaken further the rational expectations assumption and to assume that consumers use more realistic methods of information acquisition.[7]

We have developed a model which supposes consumers to learn of prices by visiting stores, and to shop pursuant to a fixed sample size strategy, with some consumers having sample sizes equalling one and others having sample sizes strictly greater than one (Wilde and Schwartz, 1979).[8] These assumptions differ from the standard ones in three ways. First, the method of acquiring information is reasonably realistic since consumers often do learn of prices by visiting stores. Further, the model's qualitative conclusions are unchanged if consumers absorb price data from ads. Second, no one in this model is perfectly informed, in the sense of knowing the distribution and the identity of all firms; rather, consumers only know what their limited

samples reveal. Third, the shopping strategy it posits is consistent with much of what is known about actual shopping behavior, since in all markets studied some consumers visit one and others more than one store, and the ''shoppers'' sometimes return to earlier stores to take advantage of favorable prices.

This model is similar in its assumptions respecting consumer preferences and firm technology to the modified version of the Salop and Stiglitz model discussed above. The only difference is that $\alpha$ now refers to the proportion of comparison shoppers and n to the number of stores they visit ($n \geq 2$). Three qualitatively distinct equilibrium configurations emerge in this model: (i) if a significant proportion of consumers sample more than one firm, a competitive equilibrium occurs--the necessary and sufficient condition for this outcome is $\alpha \geq 1 - [F/s(p_L - \hat{p})]$;[9] (ii) if somewhat fewer consumers shop, the equilibrium distribution will have a mass point at $p^*$, a gap in which no prices are charged and a continuous distribution of prices above that to the limit price $p_L$--the necessary and sufficient condition for this outcome is $\alpha < 1 - [F/s(p_L - \hat{p})] < n\alpha/(1 - \alpha + n\alpha)$; (iii) if still fewer consumers shop, the equilibrium distribution of prices will be continuous over some range $[\bar{p}, p_L]$ where $\bar{p} \geq p^*$--the necessary and sufficient condition for this outcome is $\alpha \leq n\alpha/(1 - \alpha + n\alpha) \leq 1 - [F/s(p_L - \hat{p})]$. In this final case, $\bar{p}$ rises as $\alpha$ falls; prices thus begin to mass toward the monopoly price as the percentage of comparison shoppers gets small.

This model suggests that monopolistic competition sometimes is



not the appropriate market structure in which to analyze imperfect information issues. The standard monopolistically competitive model assumes product heterogeneity. Insights drawn from the theory of monopolistic competition thus translate uneasily into search equilibrium models because these models often assume product homogeniety. Some theorists nevertheless have employed this theory to characterize market outcomes when information about price is costly to acquire in part because of their view, discussed above, that price dispersion may be common; when dispersion exists, price must exceed marginal cost for at least some firms, and this disparity is an inevitable feature of monopolistically competitive equilibria. Our model, however, makes no presumption that search costs are zero for the comparison shoppers, but a classic competitive equilibrium still can obtain in it. Thus it suggests that monopolistic competition is not necessarily the market structure best suited to analyze imperfect information problems, at least where homogeniety is assumed. In addition, a normative implication of the model is that policymakers should consider curing the effects of costly search by reducing the costs to consumers of directly comparing purchase alternatives. Studies of actual markets suggest that such cost reductions can substantially lower prices; e.g., Devine and Marion (1979).

Our model nevertheless is quite primitive. Initially, the model was designed to be of some help to decisionmakers in evaluating a market's competitive state if goods are homogeneous, but it is unilluminating if heterogeneity exists and consumers shop across

quality levels or if firms can price discriminate. Since product heterogeneity is more often characteristic of monopolistic competition than homogeneity, the policy implications of our model would appear only to be relevant to a small number of markets. Further, the model makes the standard but strong assumptions that firms have perfect information about the prices other firms charge and that consumers purchase one good or none; it treats consumers' search strategies as exogenously determined; and while it is relatively simple from a formal point of view, it is still difficult for decisionmakers to apply.[10]

## III

The analysis above implies that a useful task, from a theoretical viewpoint, is to see what equilibria would occur in models that drop the rational expectations assumption, assume real world methods of information acquisition and relatively plausible consumer search strategies and endow firms with realistic cost functions. Such models would be more likely to illuminate actual phenomena, and might provide the basis for empirical research or laboratory experiments that actually could test the effects of insufficient search on economic environments. These realistic models would also be helpful to policymakers for the reasons previously given and for another important reason. Because it is so difficult to test economic theories directly, the attractiveness of a model to decisionmakers becomes a function of the inherent plausibility of the economic story



that it tells, and this plausibility is itself largely a function of the realism of the model's specifications. Search equilibrium models have not been used by decisionmakers in part because of the strength of the assumptions they have made.

A policy focus also suggests relaxing the homogeniety assumption. This is because a crucial question, when price dispersion is observed, is whether it is a function of insufficient search, which suggests inefficiency, or of heterogeniety. We have recently developed a model in which goods of two qualities are sold and consumers have very imprecise information respecting the prices and qualities that obtain at any given firm. (Schwartz and Wilde, 1981) In consequence, the consumers are assumed to shop randomly across quality levels. The model characterizes necessary and sufficient conditions for both goods to trade at their competitive prices. This model yields three results: (i) heterogeneous goods markets are more likely to segment into roughly homogeneous subsets than is commonly supposed; (ii) when markets do not segment, heterogeniety can work to dilute the effectiveness of search, since, for example, a consumer who visits two stores that sell different qualities is in effect a nonshopper for both varieties; (iii) increases in quality density, sample sizes held constant, reduce the likelihood of competitive equilibria, since search becomes dissipated by the range of qualities.[11] This model nevertheless only begins to explore the implications of heterogeniety. Its major failing, from a policy perspective, is that it fails to characterize equilibria intermediate

between competitive and monopoly, and thus it is unhelpful to decisionmakers who want to know whether a particular heterogeneous goods market is behaving well or badly. An important next step, then, is for search equilibrium models formally to incorporate product and contract term heterogeneity.[12]

Finally, the economic analysis to date has been of limited use to policymakers because the formal models deal only with search goods, all of whose properties are observable before purchase. Much regulation, however, deals with goods or services that have experience or credence qualities. The best formal treatment of this case is found in Satterthwaite (1979). This paper analyzes a model of the medical services market and shows how an increase in the supply of physicians can cause prices to rise because the supply increase reduces the effectiveness of consumer search. Extending Satterthwaite's model or developing new models to deal with experience goods would obviously be useful.

## IV

Economists have sought to describe markets characterized by the existence of costly information, and decisionmakers, assuming these markets to be badly behaved, have been regulating them extensively. Neither group has profited much from the other. This is due in part to the usual indifference of real world regulators to theoretical work, and in part to the economists' justifiable focus on questions of theoretical rather than immediately practical



significance. Nevertheless, that regulation should become more informed seems incontrovertible. We suggest that search equilibrium models would be of greater interest both positively and normatively if their assumptions were made more realistic and if their authors at least kept in mind the questions to which decisionmakers should want answers.

FOOTNOTES

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1. Salop (1976), p. 240 (emphasis in original)

2. The empirical literature respecting the existence of price dispersion is weak. As an example, Pratt, Wise and Zeckhauser reported finding substantial price dispersion in consumer markets for ''relatively standardized products'' on the basis of telephone surveys, but the authors recognized that they did not control closely for product heterogeniety and their survey failed to eliminate the possible effects of term heterogeniety or price discrimination. The latter is reported to be a common phenomenon in markets for some of the products they considered. See Maynes (1976), p. 152. Also, some evidence is contrary to the price dispersion assumption. The most commonly traded homogeneous goods are commodities, raw materials and money. The former two are often traded on exchanges, where no dispersion exists for identical goods sold under identical terms. And



relatively little price dispersion unaccounted for by term heterogeniety or different levels of risk seems to exist in consumer credit markets. See Schwartz and Wilde (1979). Thus the extent of price dispersion in homogeneous goods markets is an open question.

3. An interesting exception is Beales, Craswell and Salop (1981).

4. This argument is similar to one recently advanced by Diamond and Rothschild (1978) in their alternative formulation of the Salop and Stiglitz model. They argue that a firm should ignore its effect on the average price charged in the market. In the context of the Salop and Stiglitz model, this means that in equilibrium the only prices charged will be the competitive price and the monopoly price since any firm which is not charging the lowest price should charge the monopoly price. Diamond and Rothschild also introduce a continuum of information acquisition costs. Together, these modifications eliminate some of the undesirable features of the Salop and Stiglitz model, but still can never yield more than two prices in equilibrium.

5. In a recent paper, Bagnoli (1980) generalizes the Salop and Stiglitz and Varian work in a model that supposes uninformed consumers to have infinite search costs and informed consumers to have zero search costs--and thus to know everything; and assumes firms to have declining average costs to a particular point and then to have a flat average cost curve over all further increases in output. This model is a useful confirmation of the earlier analyses, but does not address the comments just made.

6. The problem is that small changes in information acquisition costs can produce drastically different equilibrium price distributions or even nonexistence.

7. A recent literature has developed that analyzes dynamic models of ''matching'' processes under imperfect information-- see Mortensen (1979), Diamond and Maskin (1979, 1981) and Butters (1980). These models analyze markets in which large numbers of ''traders'' meet randomly to exchange a single unit of some homogeneous good. While they are very interesting, these models do not focus on the more standard kinds of markets with which we are concerned.

8. We justify use of a fixed sample size strategy in Wilde and Schwartz (1979) and Schwartz and Wilde (1979).

9. The necessary and sufficient condition for a competitive equilibrium in our model is identical to that in the (revised) Salop and Stiglitz model, if $c_1 = 0$. The Salop and Stiglitz model, however, has the peculiar property that when $\alpha > 1 - [F(s/p_L - \hat{p})]$ and $0 < c_1 < c_2$, there is a range of costs over which no equilibrium exists, and when $c_1$ is large enough to generate an equilibrium, it is degenerate at the monopoly price. When the condition $\alpha > 1 - [F(s/p_L - \hat{p})]$ is unsatisfied, no competitive equilibrium can occur in either model.

10. Paranjape and Wilde (1981) do relax the strong purchase and cost assumptions in our model to allow for downward sloping demand curves



and U-shaped average cost curves. They show that the qualitative conclusions of the earlier model are unaffected. Also, it turns out that markets are more likely to be competitive the more elastic the demand curve and the less elastic the average cost curve. A similar generalization of the Salop and Stiglitz model can be found in Braverman (1980).

11. This result reinforces Satterthwaite (1979), who showed, in a very different analytical framework, how an increase in the number of sellers of a differentiated service could cause prices for that service to rise.

12. Chan and Leland (1980) have recently extended the Salop and Stiglitz model to incorporate quality differences between firms. This is a difficult problem, and while Chan and Leland's model is a move toward greater realism, it still suffers from many of the underlying problems of the Salop and Stiglitz model.

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